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BASIC RESULTS OF 1947 SCIENTIFIC ACTIVITY, ACADEMY OF SCIENCES USSR

Academician N. G. Bruyevich

A series of important measures strengthening the Academy of Sciences USSR, and facilitating its further development, were implemented by the Government and Party in 1947. The Academy's 1947 budget exceeded the 1946 budget by 20 percent. An Institute of Petroleum was organized in Moscow. In Leningrad, an Institute of the Chemistry of Silicates was established. Also organized were the Sakhalin and Yakutsk scientific-research bases. Work toward organization of an Academy base in the Crimea is being conducted. Important means for the augmentation of scientific equipment of academic institutions and of the staffs of their scientific personnel were provided by the Government.

The plan of scientific works of the Academy of Sciences for 1947 included 358 problems and 107 expeditions. Since it is impossible to characterize the scientific results of each problem and expedition individually, only scientific results that may possess significance for science and for the national economy are presented.

Department of Physico-Mathematical Sciences

In conformity with the plan, 45 problems were worked out. Research projects carried out in 1947 at high altitude by an expedition of the Academy of Sciences USSR in collaboration with the Academy of Sciences Armenian SSR permitted us to establish the presence, in the composition of cosmic rays, of a whole group of elementary particles, the mass of which surpasses that of the electron 500 to 20,000 times. These particles were named "varitrons." The variation in mass of the new elementary particles is emphasized by such a designation. There is reason to believe that varitrons are unstable. They disintegrate spontaneously, being transformed into varitrons of a different mass.

The results were attained with the assistance of a new method, similar to the method of the mass spectroscopy. A large, continuous magnet was placed in the new mass spectroscopy. The cosmic particles were bent in

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their course in this magnetic field, and, with the aid of a special filter, were sorted out according to their mass. The system, with counters and moving-picture apparatus, established the trajectories of the separate cosmic particles. In all, more than 10,000 trajectories of varitrons were registered.

The discovery of new elementary particles -- varitrons -- has real importance in contemporary physics.

For the purposes of illumination engineering, great importance is attached to such luminescent compounds that may be charged in the evening and then shine all night. Until recently, alkali earth compounds possessed the greatest duration of afterglow, but they are rapidly destroyed by moisture. In 1947, the P. N. Lebedev Physical Institute achieved substantial success in the preparation of a moisture-resistant compound with long afterflow. The derived compounds are the equal of the alkali-earth compounds in duration of afterglow, and are completely moistureproof. New experiments conducted by the Institute prove the existence of a migration of energy from excited to unexcited molecules in luminescent solutions. Experiments consisted of the investigation of the reduction of the polarization of the luminescence, lasting 10^{-9} second, upon the extension of its duration. The results of these investigations again proved the correctness of the resonance theory of the transmission of energy in luminescent solutions developed by Academician S. I. Vavilov.

The Brazilian expedition of the Academy of Sciences USSR to study the solar eclipse in 1947 established the distribution of emissions of meter radio-waves in the region of the sun. It seems that the intensity of the radio-emission of the sun fell 45 percent during the eclipse. This demonstrates that the radio-emission of 1.5 meter-long waves originates in the high levels of the sun's corona. The data of the measurements also proved that the distribution of the intensity of radio-emission of 1.5-meter waves coincided with distribution of the intensity of the protuberances of the corona.

A great meteorite, the so-called Sikhote-alinskij meteorite, fell in Primorskiy Krai 12 February 1947. Exploration of the impact site of the meteorite, conducted by a special expedition of the Academy, revealed the unusual phenomenon of a rain of iron meteorites on dry land, when thousands of separate fragments had fallen onto the earth's surface totaling not less than 100 tons. Study of the meteorite yielded new data concerning the movement of a metallic body in the atmosphere with cosmic and supersonic velocities. Study of the structure and composition of the fallen meteoric substance open possibilities for revealing new and unknown conditions of the formation of chemical unions (of minerals) existing in interplanetary space.

The site of impact was explored in detail, and a few thousand fragments of the meteorite were collected, including up to 5 tons of debris. These individual fragments are unique in the world.

As a result of partial exploitation of the collected materials, it has been established that the meteorite was one of the small asteroids. Completing its journey around the sun, it entered the gravitational influence of the earth with a relative velocity of 15 kilometers per second. Meeting the resistance of the earth's atmosphere, it was fragmented into a few thousand pieces. At the altitude of a few kilometers above the earth's surface, all the parts of the meteorite finally lost their cosmic velocity and began to fall almost vertically upon the earth (at an angle of about 60 degrees). Large masses (fragments) had a supersonic velocity at the earth's surface.

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Department of Chemical Sciences

In conformity with the plan, 31 problems were worked out. The geochemistry of isotopes of oxygen was investigated at the V. I. Vernadskiy Institute of Geochemistry and Analytic Chemistry. It was established that heavy oxygen, O^{18} , is contained in increased quantities in organic substances and in the water of the earth. Air, and especially carbon dioxide, contain a greater amount of heavy oxygen. The high content of heavy oxygen in carbon dioxide explains its concentration in the tissues of organisms. It seems that the content of heavy oxygen varies appreciably in different minerals. As a result of these investigations, a new, original method for the identification of natural bodies containing oxygen was developed. Knowing the proportion of isotopes of oxygen in different minerals, one may judge the conditions of origin, the thermal environment, and possibly the age of the given body.

A new theory of the corrosion of alloys and of complex metallic structures was developed in the Institute of Physical Chemistry. Such important problems as the corrosion of iron, the resistance of aluminum alloys, and the resistance and corrosion of stainless steels are in an appreciable degree resolved on the basis of the new theory. In this theory, alloys with complex structure, prepared from different metals, are looked upon as complex multi-electrode electrochemical systems. Electric currents developing in such multi-electrode systems either facilitate corrosive effects, or, on the contrary, reduce them, depending upon the direction of the current flow. On the basis of the new theory, it is possible to consider a complex multi-electrode system and anticipate the behavior of the structure and alloy in a corrosive relation. Such a very important practical problem concerning intercrystalline corrosion of stainless steels is also solved.

Department of Geological-Geographic Sciences

In conformity with the plan, 36 problems were worked out. The first phase of complex geological investigations of the metallogenesis of eastern USSR, in a vast expanse of territory embracing the Transbaykal, Amur, and Primorskiy regions, was completed by the Institute of Geological Sciences. This territory constitutes part of the so-called Pacific Ocean ore region. As a result of the explorations, especially promising areas were delimited, as were, on the other hand, areas of poor promise in respect to minerals; also, the characteristics of ores in individual regions were exposed. Regions with a predominance of sedimentary deposition and with thick lava deposits were determined within the extent of the ore-bearing territories. A series of new areas promising for prospecting for mineral resources were designated on the basis of the nature of the geological structure of the two above-mentioned types of areas and of the conditions of development of this or that ore deposit in each of these two types.

Upon the request of the government of the Bulgarian People's Republic, the Soil Institute of the Academy of Sciences USSR conducted a special expedition of the Ministry of Agriculture of the Bulgarian People's Republic in the investigation of the soil deposits of Bulgaria. In conjunction with Bulgarian soil scientists, a classification of the soils was worked out and a soil map of the Republic was drawn up. New perspectives of agricultural exploitation of Bulgarian soil were formulated. These materials were examined and approved by the Bulgarian Academy of Arts and Sciences.

Important data concerning new resources of the medicinal mineral waters in the Caucasus were received by the Laboratory of Hydrogeological Problems imeni P. P. Savarenskiy. The origin of the different types of medicinal waters was investigated and the complex mosaic of their distribution was ascertained. It was established that the mineral water resources are significantly greater than was earlier surmised. New sites of valuable

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mineral waters and appreciable resources of fresh water, which formerly were unknown, were found. The results of this work were accepted by the Ministry of Public Health USSR.

The Soil Institute V. V. Dokuchayev consummated many years of research and published a two-volume monograph, "The Origin and Character of Saline Soils." A general theory was set forth, throwing light on the processes of movement and deposition of salt in ground waters and in soils; the kinds of water-salt conditions of irrigated soils leading to salt contamination were determined; the conditions of growth and reclamation of the greater irrigated oases of the USSR were characterized from the point of view of the development of new irrigation and amelioration of saline soils; and greater measures for amelioration of saline soils by means of irrigation, under the conditions in the USSR, were proposed.

Department of Biological Sciences

In conformity with the plan, 83 problems were worked out. For a number of years, investigations of antibiotics were conducted in the Institute of Microbiology in conjunction with the Institute of Biochemistry for the purpose of producing Soviet antibiotic preparations. In 1947, new, important preparations were developed which possessed great antibiotic activity. These new antibiotics proved very stable even under the influence of foreign agents and during storage. According to laboratory data, these new preparations are effective against many microorganisms.

It was established by investigations of the Institute of Physiology in 1947 that the method of direct application of medicinal substances upon the central nervous system in the treatment of tetanus, virus encephalitis, intoxication in pregnancy, and in the treatment of tubercular meningitis produced remarkable results. In children, tubercular meningitis inevitably proved fatal in less than 3 weeks from the onset; however, the introduction of antibiotics according to the method of the Institute of Physiology saved 50 percent of the cases. Very commendable results are attained through early use of the method.

A question concerning the nature of the quiescent period of plants was worked out by the Institute of Botany. The entrance of a plant into its quiescent stage is accompanied by a separation of the cell's protoplasm from its walls. Multicellular organisms thus come to be like a colony of separate cells. Thanks to the ability of the plasma to remain separated, ice crystals appearing in the cells at low temperatures do not produce mechanical destruction of the tissues. The emergence of plants from the quiescent period is due to a series of biochemical processes arising within the cells. New theoretical results permit us to draw a few practical conclusions. Taking advantage of a new method, it is now easy to establish whether a plant is in the quiescent period, or whether it has already issued from it. One may easily control the effectiveness of methods of artificially bringing plants out from the quiescent period, or, on the other hand, of artificially prolonging this period. Good synthetic preparations have been found that bring the potato out of quiescence after the summer planting of freshly collected tubers, or else prolong the period.

In the process of transmission of an impulse in a nerve, a disturbance of the electrical and chemical state and orientations of molecular complexes take place. Electrical phenomena and chemical processes in the nerve trunk have long been subjected to detailed study. Investigations, however, of structural changes did not progress, as indispensable delicate methods did not exist. A new, very delicate method developed in the I. P. Pavlov Physiological Institute permits rapid registration of these changes by means of successive determination of the tensile properties of a nerve. Due to this new method, there is now the possibility of throwing new light on the functional state of a nerve and, most important of all, upon processes of excitation.

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Department of Technical Sciences

In accordance with the plan, 36 problems were worked out. The theory of the bipolar corona of a direct current was developed in the Institute of Power imeni G. M. Krzhizhanovskiy. The development of the so-called "corona," that is, the ionization and luminescence of a narrow layer of air at the surface of the conductor, leads to a significant loss of energy at high voltages of the electrical transmission lines. For the construction of ultra-high-voltage direct-current lines, the restriction of corona loss is a decisive factor in the selection of the type and construction of the lines. The studies of the Power Institute investigated in detail the mechanism of simultaneous corona discharge of two parallel lines of different polarity (bipolar corona), which, until this time, had remained obscure. A theoretical resolution of this problem was found.

The theory developed found confirmation through comparison of theoretically calculated losses of energy with experimental data.

New results have been obtained in the realm of dynamics of machines at the Institute of Machine Sciences. The problem concerning the movement of machines under the action of driving power, depending not only on the machine's position, but also upon speed of rotation of the shaft and upon time, was solved. Processing machines, driven by electric motors or by electric motors and heat engines simultaneously, are typical of this situation. A convenient, practical method, permitting detection of all movements of a machine (from start to stop) was evolved.

Theory and actual construction of a new type of transformer for arc welding were completed in the Section of Scientific Treatment of Electric Welding and Electrothermics. A new method of calculating the character of the performance of welding transformers was developed. The foundations for the selection of a rational plan were established, and forms of the external characteristics and methods of regulation of the transformers were determined. By means of experiments on the new transformer models under industrial conditions, it was established that they possess electrical characteristics guaranteeing a steady arc over a wide current range.

An investigation, the objective of which was the determination of the dependence of the heat endurance of light alloys upon their composition and structure, was completed in the Institute of Metallurgy. For the study of the heat-resistant properties of metallic alloys in this work, new methods were employed, based upon determination of the rate of indentation of hard macro- and micro-indentors into the material being tested at the assigned temperatures.

Department of History and Philosophy

In conformity with the plan, 42 projects were worked out. A few great archaeological expeditions were undertaken by the Institute. New results were attained by the Khoresm archaeological expedition. Excavations of the ancient city of Toprak-kal revealed a great, beautifully finished court area of about 6,000 square meters, made up of 70-100 apartments and disposed in three levels. Abundant and varied material were found, thoroughly characterizing the culture and way of life of the inhabitants of Khoresm in the 3d century A.D.

Excavations in Staraya Madoga also yielded exceptionally valuable and interesting results.

Substantial work in the selection and preparation of cadres has been carried on by the Academy of Sciences. The certification of the directors of sections, laboratories, and sectors, and of aspirants and doctorate candidates was completed. The certifications of a few directors of sections were not approved. The certification of directors permitted improvement of

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the quality of scientific leadership in the Institutes. The scarcity of qualified scientific cadres of both affiliate and base institution was also revealed.

A few institutes -- Physical Chemistry, Oceanology, Microbiology, Crystallography, and others -- were obliged to improve laboratory work and section leadership and to eliminate deficiencies revealed in certification. The directors of these scientific institutions received corresponding directives at the end of 1947.

The system for preparing scientific cadres in the Academy was reorganized and improved. As a basis for this preparation, scientific and educational institutes assign their most outstanding scientific collaborators to the USSR Academy of Sciences' Doctorate School. This new method will assist in producing young Soviet scientists, and in providing cadres for the academies of sciences of the Union Republics, the institutes of higher education, and industrial institutes. Aspirants' requirements were raised and the system of control over the preparation of Candidates of Sciences was improved. Yearly recertification of aspirants was instituted. Attention was directed to the necessity of broadening the preparation of cadres in such important specialties as philosophy, logic, political economy, the Russian language, history, physics, and modern technical practices; the preparation of cadres on these subjects has been unsatisfactory in the past.

The Presidium of the Academy continued work begun in 1945 concerning the awarding of the rank of senior scientific collaborator to scientific workers of the Academy. Several suggestions were rejected in secret vote after detailed study by the Presidium. It should be emphasized that the scientific councils of scientific institutions of the Academy are not always sufficiently energetic in stimulating the presentation of petitions for appropriation of the rank of senior scientific collaborator to individual scientists before the Presidium of the Academy.

In the past year, the observations of the Academy secretaries for cadres in all departments were supported by the Presidium. The departments carried on a large amount of cadre work in connection with certification.

The Presidium devoted a series of meetings to the question of cadres.

Four sessions of the Central Meeting of the Academy of Sciences were held during the year at which scientific reports were heard, elections of vice-presidents, members of the Presidium, and directors of academic institutions were held, as were also elections of Associate Members from a number of prominent, progressive foreign scientists.

The great session of the year was held in connection with the 30th anniversary of the October Revolution. Thirty-four scientific reports were heard at the sessions. Representatives of all of the academies of sciences of the Union Republics and also representatives of branch academies of sciences spoke, in addition to the colleagues of the Academy presenting reports. In commemoration of the 30th anniversary of the October Revolution, the Academy of Sciences issued a two-volume collection, setting forth the achievements of Soviet science. [Available in CIA; see FDB Summary No 8, 26 April 1948.]

The publishing activity of the Academy of Sciences USSR in 1947 was appreciably broadened: the output of books in 1947 was 30 percent higher than in 1946. The greater number of books published concerned history, biology, and geologo-geographic studies, while a large number of books were of a popular-scientific character.

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Work on the construction of buildings for the Academy of Sciences was significantly increased in 1947. Near Leningrad, restoration was continued of the Great Astronomical Observatory (at Pulkovo), of the Aleksander Court, and of the Pushkin Lyceum (in the city of Pushkin). Construction of a new astrophysical observatory was begun in the Crimea.

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